



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/635,422

08/06/2003

Wolfgang Holzapfel

56/415

7327

757

7590

03/29/2006

BRINKS HOFER GILSON & LIONE

P.O. BOX 10395

CHICAGO, IL 60610

EXAMINER

ANDERSON, DENISE BROWN

ART UNIT

PAPER NUMBER

2877

DATE MAILED: 03/29/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

20

Office Action Summary	Application No.	Applicant(s)	
	10/635,422	HOLZAPFEL ET AL.	
	Examiner	Art Unit	
	Denise B. Anderson	2877	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 November 2005 and 23 November 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-38 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-38 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>1/30/06</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Drawings

1. The examiner accepts the changes to the drawings submitted on 11/03/05.

Specification

2. The examiner accepts the changes to the abstract (submitted on 11/23/05) and to paragraph 0041 of the specification (submitted on 11/03/05).

Claim Objections

Claims 4, 6, 13, 14, 19, 21, 32, and 36 objected to because of the following informalities: See below. Appropriate correction is required.

3. The applicant has amended claim 13, deleting the word "grating", instead of actually replacing the word "scanning" with the word "scale" as indicated on page 15 of applicant's response. Thus, the examiner believes that applicant's deletion of the word "grating" is a typo.

4. Claims 4, 6, 14, 19, 21, 32, and 36 recite the limitation "the + 1st order of diffraction" and "the - 1st order of diffraction". There is insufficient antecedent basis for these limitations in the claim. The word "the" should be replaced with the word "a".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4, 6, 16-19, 21, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959) further in view of Takamiya et al (US Patent No. 6,005,667) and Brake (US Patent No. 4,079,252).

5. As to claims 1 and 16, the applicant claims a light source connected to an object; an optical element; a scale grating connected to a second object; first and second partial beams of rays split by the scale grating; first and second scanning gratings receiving first and second partial beams of rays, respectively, and further splitting partial beams into 3rd and 4th, and 5th and 6th partial beams, respectively; relative movement between the scale grating and the light source, a periodically modulated interferential fringe pattern in a detection plane; a detection arrangement for detecting at least 3 phase-shifted scanning signals; and a matching between the detection period of individual detector elements and the spatial interferential pattern period.

In figure 1, Michel et al discloses a light source 1 connected to a first object such as a reading head movable with respect to the scale grating (see reference to the beam course in column 2, lines 29-31, where the European Patent Application 0 163 362 B1 is disclosed); an optical element (lens 2) arranged downstream from the light source and produces an incoming beam of rays; and scale and scanning gratings (3, 4, and 3'). Michel et al further discloses a first set of diffracted partial beams from the first grating (column 2, lines 34-39), a second set of diffracted partial light beams generated by the second grating (column 2, lines 40-44), and a third grating that causes the second set of diffracted light beams to interfere with one another (column 2, lines 44-49). There is a fringe pattern suggested by the mere fact that the beams are brought to interfere. The

Art Unit: 2877

interfered beams are projected along 3 different spatial directions onto subsequent photodetectors (see column 2, lines 50-58 and the photodetectors 5, 6, and 7 in figure 1). In this case, the detection arrangement would include the diffraction grating 3' where the partial beams interfere; the optical elements 11, 12, and 13 which focus the interfered beams along 3 different spatial directions; and the photodetectors 5, 6, and 7.

Michel et al does not disclose separated first and second scanning gratings for receiving the first and second partial beam of rays. Michel et al uses a single grating for this purpose (i.e., an integral structure where the two diffraction areas which receive the first and second partial beams are co-located). Takamiya et al discloses two separate gratings (5a and 5b in figure 1) for receiving the \pm first-order diffraction light beams. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al with the teachings of Takamiya for the purpose of altering an integral structure to one with separate parts or vice versa.

Michel et al does not disclose a matching between the detection period of individual detector elements and the spatial interferential pattern period. Brake discloses a third grating that acts as a detection grating and has a period which is of the same period as the fringe pattern (column 3, lines 34-40) and individual photosensitive devices (detector elements 8-11 in figure 1) whose outputs represent the fringe pattern at phase-specific points (column 2, lines 45-55). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al with the teachings of Brake for the purpose of more effectively responding to

Art Unit: 2877

different parts of the spatially periodic distribution of radiation and enabling use of larger photosensitive devices.

6. As to claims 2 and 17, the applicant claims that the light source is a semiconductor light source. Michel et al does not disclose the type of light source used. Takamiya et al discloses the use of a laser diode (see reference numeral 1 in figure 1 and column 3, line 24) as a source of light for use in a displacement measuring apparatus. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al with the teachings of Takamiya et al for the purpose of achieving position measurements with a light source that provides low power consumption, such as a semiconductor light source.

7. As to claims 3 and 18, the applicant claims that the optical element comprises a lens. Michel et al discloses a lens (2) in figure 1 for collimating the light (1).

8. As to claims 4, 6, 19, and 21, the applicant claims that the scale and scanning gratings are phase gratings and that the 1st and 2nd partial beams (and the 3rd and 4th partial beams) correspond to the +/- 1st orders of diffraction. Michel et al discloses that the diffracted partial beams are of the 0th, and +/- 1st orders. Michel et al does not disclose whether the scale and scanning gratings are phase or amplitude gratings. Takamiya et al discloses phase type gratings (column 3, lines 29-30 and line 38; column 4, lines 24-25). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al with the teachings of Takamiya et al for the purpose of extinguishing the zero order beam by using a phase grating.

9. As to claims 29 and 30, the applicant claims that the detector period is matched to the fringe pattern period so that detector elements have scanning signals phase-shifted by 90° with respect to each other and that there are 4 such detector elements. Michel et al does not disclose the claimed features of claims 29 and 30. Brake et al discloses 4 photosensitive detectors (8, 9, 10, and 11 in figure 1) and describes the detector matching to the fringe pattern in column 2, lines 45-55. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al with the teachings of Brake et al for the purpose of responding to different parts of the spatial distribution in the detection area.

Claims 5, 7, 20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252) and further in view of Michel et al (US Patent No. 6,885,457).

10. As to claims 5, 7, 20 and 22, the applicant claims a specific bar-to-gap ratio and phase depth for the phase grating. In claims 7 and 22, the applicant further discloses that the scanning grating has a graduation period less than that of the scale grating and that the detector grating period is twice that of the fringe pattern period. Michel et al (959), Takamiya et al, and Brake do not disclose the specific phase grating parameters (bar-to-gap ratio, phase depth, and grating period). Michel et al (457) discloses that gratings may have a phase depth of 180° (column 7, line 1) and a unity bar-to-gap ratio (column 6, lines 61-62). Further disclosed is the possible arrangement of graduation structures with different graduation periods. Since the periods are different, this implies

Art Unit: 2877

that one is smaller than the other. Furthermore, the scale and scanning gratings claimed by the applicant are of the same type—diffraction phase gratings. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al (959), Takamiya et al, and Brake with the teachings of Michel et al (457) for the purpose of incorporating specific grating parameters that can be used to suppress or allow the transmission of different diffraction orders and for subsequently, generating selected phase-shifted signals in the detection plane.

Claims 8 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252) and further in view of Huber (US Patent No. 6,151,128).

11. As to claims 8 and 23, the applicant claims that the first and second scanning gratings are arranged together on a scanning plate. Michel et al, Takamiya et al, and Brake do not disclose a single plate holding two separated scanning gratings. Huber discloses a scanning plate AP with 2 phase gratings AF1 and AF2 (figure 1a). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al, Takamiya et al, and Brake with the teachings of Huber for the purpose of diffracting specific partial beams of light and avoiding unwanted scattered light.

Claims 9, 24, 34, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252), Huber (US Patent No. 6,151,128) and further in view of Meyer et al (US Patent No. 5,493,399).

12. In claims 9 and 24, the applicant claims that the scanning plate is opaque outside the scanning grating areas. Michel et al, Takamiya et al, Brake, and Huber do not disclose an opaque scanning plate. Meyer et al discloses side-by-side scanning fields (numeral 10 in figure 2) separated from each other by opaque regions (column 3, lines 46-48). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al, Takamiya et al, Brake, and Huber with the teachings of Meyer et al for the purpose of receiving or generating selected diffraction orders as Huber describes in column 1, lines 34-35.

13. Regarding new claims 34 and 37, the same rejection applied to claims 9 and 24 also apply to claims 34 and 37, since the applicant has only added the specific $\pm 1^{\text{st}}$ orders of diffraction to make claims 34 and 37 different from claims 9 and 24. Furthermore, the motivation used in claims 9 and 24 state that "selected" diffraction orders are received or generated, which would include the $\pm 1^{\text{st}}$ orders of diffraction. *

Claims 10-12 and 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252), and further in view of Holzapfel (US Patent No. 5,814,812).

Art Unit: 2877

14. As to claims 10-12 and 25-27, the applicant claims that the first scanning grating is a distance a_1 from the scale grating. The applicant further claims a specific relationship between the graduation period and the distances between the scale and scanning grating and between the scanning and detection gratings. It is important to note first that the applicant describes all gratings as phase gratings. Next, it is important to note that the applicant cites the reason for selection of distances and grating periods on page 9 of the specification (see paragraph 0037). The selection reason is to eliminate harmonic wave portions from the generated phase signals. Michel et al, Takamiya, and Brake do not disclose a specific relationship between the graduation period and the distances between gratings. Holzapfel discloses a device for filtering harmonic signal components that can be used in position measuring systems and a relationship between grating periods and grating distances (column 4, lines 21-39). Though the specific relationship of Holzapfel is not identical to what the applicant claims, they serve the same purpose – to filter harmonic wave portions. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al, Takamiya et al, and Brake with the teachings of Holzapfel for the purpose of generating phase signals which are not disturbed by harmonic wave portions and thus, have the desired wave trend for the periodic output signals (see Holzapfel, column 1, lines 39-45).

Claims 13, 28, 35 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US

Art Unit: 2877

Patent No. 6,005,667), Brake (US Patent No. 4,079,252), and further in view of admitted prior art.

15. As to claims 13 and 28, the examiner interprets that the applicant claims that the scale (not scanning) grating is arranged in an area of the beam waist of the rays generated by the optical element. Michel et al, Takamiya et al, and Brake do not disclose the specific arrangement of the scale grating with respect to the beam waist of the incoming light rays. This specific arrangement has been described by the applicant as prior art in the background of the invention, and is therefore, admitted prior art (see also US Patent No. 6,005,667 as mentioned by the applicant). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al, Takamiya et al, and Brake with the teachings of the admitted prior art for the purpose of having the beam waist correspond to several grating lines or more.

16. Regarding new claims 35 and 38, the applicant adds that incoming beam of rays is a TEM 00 mode Gaussian beam. Michel, Brake, and Takamiya et al are silent on the mode of the Gaussian beam. Takamiya et al does describe use of a lens system to shape the light beam. It would have been obvious to one of ordinary skill in the art at the time of the invention to shape the laser beam of Takamiya et al and use it in Michel et al to achieve a TEM 00 mode for the purpose of avoiding astigmatic effects due to an imperfect Gaussian laser beam.

17. Further regarding new claims 35 and 38, the applicant adds that at the area of the beam waist, the product of the divergence and the beam diameter is at a minimum.

Art Unit: 2877

Michel, Brake, and Takamiya et al are silent on the minimum product defining the Gaussian beam. Takamiya et al does describe a beam waist as has already been rejected for claims 13 and 28 (see column 3, lines 44-51 of Takamiya et al). Furthermore, Takamiya et al states that the diameter of the laser beam is selected based on the grating pitch. It would have been obvious to modify the beam diameter of Takamiya et al to correspond to the pitch of the grating used in Michel et al for the purpose of improving system performance (i.e., achieving an interference signal that is of high intensity).

Claims 14, 32, 33 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252), and further in view of Huber (5,430,546).

18. As to claim 14, the applicant claims that the $\pm 2^{\text{nd}}$ orders of diffraction are split from the detection arrangement that is embodied as a phase grating. Michel et al, Takamiya et al, and Brake do not disclose splitting into $\pm 2^{\text{nd}}$ orders of diffraction. Huber (546) discloses a detection arrangement embodied as a phase grating (reference numeral 4 in figure 1) that splits light beams into $\pm 2^{\text{nd}}$ orders of diffraction (column 4, lines 52-66). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al, Takamiya et al, and Brake with the teachings of Huber (546) for the purpose of obtaining signals of higher intensity and thus, higher resolution.

Art Unit: 2877

19. Regarding new claims 32 and 36, Michel et al, Takamiya et al, and Brake are silent on the orders of diffraction for the 3rd and 4th partial beams and the 5th and 6th partial beams. In column 4, lines 52-65 and in figures 1 and 2, Huber show that the +/- 1st orders of diffraction can be used. It would have been obvious to modify Michel et al, Takamiya et al, and Brake with the type of diffraction gratings used by Huber for the purpose of achieving the +/- 1st orders of diffraction for any set of partial beams.

20. Regarding new claim 33, the same rejection applied in claim 14 applies to claim 33, as Huber points out also in the abstract that the diffracted partial beams may be of the +/- 2nd orders of diffraction and have the desired intensity.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252), Huber (5,430,546), and further in view of Michel et al (US Patent No. 6,885,457).

21. As to claim 15, the applicant discloses a bar-to-gap ratio that is not 1:1, a phase depth that is not 180°, and a detector grating period of twice the fringe pattern period. Michel et al (959), Takamiya et al, Brake, and Huber does not disclose the grating parameters claimed by the applicant. Michel et al (457) discloses that gratings may have a phase depth of 180° (column 7, line 1) and a unity bar-to-gap ratio (column 6, lines 61-62). Further disclosed is the possible arrangement of graduation structures with different graduation periods. Since the periods are different, this implies that one is smaller than the other and the amount by which it is smaller could be any number.

Furthermore, the scale and scanning gratings claimed by the applicant are of the same type—diffraction phase gratings. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al (959), Takamiya et al, Brake, and Huber with the teachings of Michel et al (457) for the purpose of incorporating specific grating parameters that can be used to suppress or allow the transmission of different diffraction orders and for subsequently, generating selected phase-shifted signals in the detection plane.

Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Michel et al (US Patent No. 5,760,959), Takamiya et al (US Patent No. 6,005,667), Brake (US Patent No. 4,079,252), and further in view of Hercher (US Patent No. 5,530,543).

22. As to claim 31, the applicant claims that the individual detector elements are connected in an electrically conducting manner that provides identically phased scanning signals. Michel et al, Takamiya et al, and Brake do not disclose an electrically conducting connection between detector elements. Hercher discloses a detector array for use in interferometric metrology systems. The outputs from detector array elements are electrically interconnected so as to form three or more signals displaced from one another in phase by a fixed amount (see abstract and figure 1A). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teachings of Michel et al, Takamiya et al, and Brake with the teachings of Hercher for the purpose of enhancing the accuracy of generating absolute phase information that is used to determine desired displacement.

Response to Arguments

23. Applicant's arguments filed on 11/03/05 and 11/23/05 have been fully considered but they are not persuasive. Regarding applicant's argument (in claims 1-31) that the examiner's prior art reference teaches that the scale grating is placed after the scanning grating, rather than the scale grating being prior to the scanning grating as claimed by the applicant: the applicant has defined in paragraph 0028 of the specification that the scale grating is a diffracting phase grating. Applicant's scanning and detecting gratings are also phase gratings. Merely naming one of the gratings a scale grating and the others scan gratings do not change the functionality/definition of a grating -- A framework or latticework having an even arrangement of rods, or any other long narrow objects with interstices between them, used to disperse light or other radiation by interference between wave trains from the interstices. Furthermore, relative movement of any of the gratings with respect to one another accomplishes the same result -- the interferential partial light beams needed to do position measurements. So, one could move the scanning gratings or the scale gratings and still achieve "relative" movement, leading to the necessary information for obtaining position measurements.

FINAL REJECTION

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

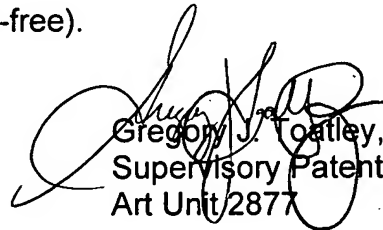
Fax/Telephone Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Denise B. Anderson whose telephone number is 571-272-8324. The examiner can normally be reached on Mon-Fri (9:30 AM - 6 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley Jr. can be reached on 571-272-2800 ext. 77. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Denise B Anderson, PhD
Patent Examiner
Art Unit 2877



Gregory J. Toatley, Jr.
Supervisory Patent Examiner
Art Unit 2877

DBA